

AMENDMENTS TO THE CLAIMS

The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) A switching power source apparatus comprising:
 - a first series circuit being connected to each end of a DC power source and including a primary winding of a transformer and a main switch those are connected in series;
 - a rectifying-smoothing circuit to rectify and smooth a voltage that is outputted from a secondary winding of the transformer when the main switch is turned on;
 - a second series circuit being connected to each end of the main switch or to each end of the primary winding of the transformer and including an auxiliary switch and a clamp capacitor those are connected in series;
 - a third series circuit being connected to each end of the main switch and including a first diode and a snubber capacitor those are connected in series;
 - a fourth series circuit being connected to a node between the first diode and the snubber capacitor and a node between the auxiliary switch and the clamp capacitor and including an auxiliary winding of the transformer and a second diode those are connected in series; and
 - a control circuit to alternately turn on/off the main switch and auxiliary switch, wherein
 - the snubber capacitor is discharged through the auxiliary winding to the clamp capacitor when the main switch is turned on; and
 - the snubber capacitor is charged when the main switch is turned off, to relax the inclination of a voltage increase of the main switch.

2. (Original) The switching power source apparatus of claim 1, wherein
the control circuit is configured to turn on the auxiliary switch to saturate magnetic
flux in a core of the transformer and
turn off the auxiliary switch to make the main switch conduct zero-voltage switching
as an exciting current increases.

3. (Currently amended) The switching power source apparatus of claim 1 ~~or 2~~,
wherein the rectifying-smoothing circuit has

a fifth series circuit including the secondary winding and a tertiary winding of the
transformer,

a sixth series circuit being connected to each end of the fifth series circuit and
including a first rectifying diode and a smoothing capacitor, and

a second rectifying diode being connected to a node between the secondary winding
and the tertiary winding and a node between the first rectifying diode and the smoothing
capacitor.

4. (Original) The switching power source apparatus of claim 3, wherein the primary
and secondary windings of the transformer are wound around the core of the transformer so
as to provide a leakage inductance;

the primary and tertiary windings of the transformer are wound so as to provide a
leakage inductance that is smaller than the leakage inductance provided by the primary and
secondary windings; and

the primary and auxiliary windings of the transformer are wound so as to provide a
leakage inductance that is smaller than the leakage inductance provided by the primary and
secondary windings and larger than the leakage inductance provided by the primary and
tertiary windings.

5. (Original) The switching power source apparatus of claim 4, wherein a magnetic path of the core of the transformer has a portion with reduced cross-sectional area.

6. (Original) A switching power source apparatus comprising:
a first series circuit being connected to each end of a DC power source and including a primary winding of a transformer and a main switch those are connected in series;
a rectifying-smoothing circuit to rectify and smooth a voltage that is outputted from a secondary winding of the transformer when the main switch is turned off;
a second series circuit being connected to each end of the main switch or to each end of the primary winding of the transformer and including an auxiliary switch and a clamp capacitor those are connected in series;
a third series circuit being connected to each end of the main switch and including a first diode and a snubber capacitor those are connected in series;
a fourth series circuit being connected to a node between the first diode and the snubber capacitor and a node between the auxiliary switch and the clamp capacitor and including an auxiliary winding of the transformer and a second diode those are connected in series; and
a control circuit to alternately turn on/off the main switch and auxiliary switch,
wherein

the snubber capacitor is discharged through the auxiliary winding to the clamp capacitor when the main switch is turned on;
the clamp capacitor is discharged through the secondary winding to the rectifying-smoothing circuit when the auxiliary switch is turned on; and
the snubber capacitor is charged when the main switch is turned off, to relax the inclination of a voltage increase of the main switch.

7. (Original) The switching power source apparatus of claim 6, wherein the rectifying-smoothing circuit has a series circuit of a rectifying diode and a smoothing capacitor that is connected to each end of the secondary winding of the transformer.
8. (Original) The switching power source apparatus of claim 7, wherein the primary winding and secondary winding of the transformer are wound around a core of the transformer so as to provide a leakage inductance, and the primary winding and auxiliary winding of the transformer are wound so as to provide a leakage inductance that is larger than the leakage inductance provided by the primary winding and secondary winding.
9. (New) The switching power source apparatus of claim 2, wherein the rectifying-smoothing circuit has
 - a fifth series circuit including the secondary winding and a tertiary winding of the transformer,
 - a sixth series circuit being connected to each end of the fifth series circuit and including a first rectifying diode and a smoothing capacitor, and
 - a second rectifying diode being connected to a node between the secondary winding and the tertiary winding and a node between the first rectifying diode and the smoothing capacitor.

10. (New) The switching power source apparatus of claim 9, wherein the primary and secondary windings of the transformer are wound around the core of the transformer so as to provide a leakage inductance;

the primary and tertiary windings of the transformer are wound so as to provide a leakage inductance that is smaller than the leakage inductance provided by the primary and secondary windings; and

the primary and auxiliary windings of the transformer are wound so as to provide a leakage inductance that is smaller than the leakage inductance provided by the primary and secondary windings and larger than the leakage inductance provided by the primary and tertiary windings.

11. (New) The switching power source apparatus of claim 10, wherein a magnetic path of the core of the transformer has a portion with reduced cross-sectional area.